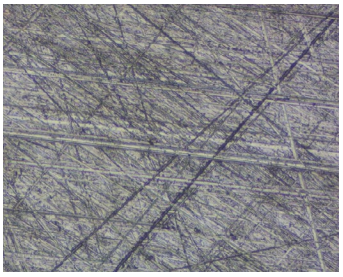
nGauge AFM

Metals & Minerals

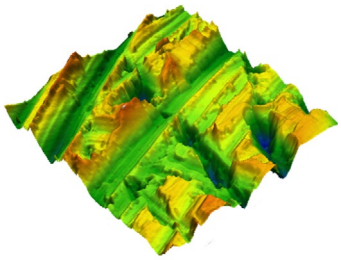
The nGauge Atomic Force Microscope (AFM) is an excellent choice for micro- and nano-scale metallography for applications such as automotive, aerospace, or electronics. It is ideal as a complementary technique to typical metallurgical microscopy, and can be used to inspect a variety of structural and material properties as well as grinding methodologies.

As an example, the nGauge can be used to inspect a steel sample which has been polished by a polycrystalline diamond suspension. In the below optical microscope image, a steel plate has been polished with 9-micron polycrystalline diamonds, showing streaks across the sample. While the scratches can be clearly seen, optical microscopy provides very little quantitative data. Not only does it prohibit the measurement of the depth of the scratches, but the measurement accuracy of the width of the scratches is constrained by the limited resolution of optical microscopy which is generally at best ~200 nm.

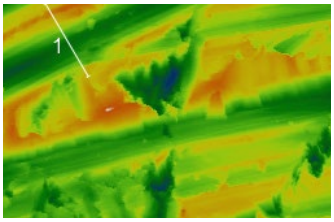


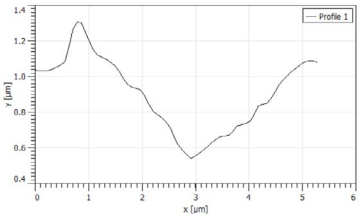
Polished steel sample under an optical microscope

Under the nGauge AFM however, the features of the sample can be seen with much greater resolution. Even with a wide field of view (FOV) scan (20um x 20um) and fast scanning speed (80s, 256x256px), each pixel of the scan is >80 nm. With the high resolution, 1024x1024 scan on the nGauge, even at this wide 20um FOV, the resolution would be increased a further 16x, with sub 20nm pixels, 100x higher spatial resolution than the best optical microscopes! Furthermore, three-dimensional data obtained from the nGauge provides the ability to measure features on the sample quantitatively. As an example, it is possible to take an arbitrary line profile over one of these scratches to accurately measure its width and depth, in this case showing 0.8um deep trenches with a V profile. Using this data, it is also easy to calculate the density of scratches on the surface.



3D image of the polished steel sample under the nGauge AFM

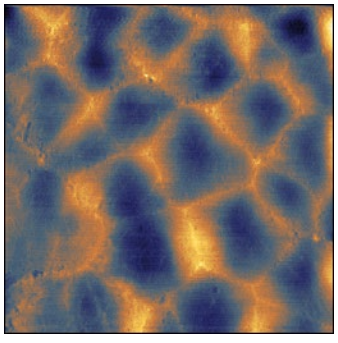




Line profile over AFM data

Furthermore, the nGauge allows for collection of quantitative measurements of the surface roughness of the sample along with other statistical quantities. This is very useful when looking at a polished sample, because the roughness is a quantitative indicator of the quality and consistency of the polishing procedure. This enables accurate quality control and provides excellent data to present to customers and to use for marketing applications.

Another type of sample which the nGauge excels at examining is a mineral sample. One example of such an application is the characterization of calcium carbonate (CaCO3) aragonite crystals which make up the nacre layer of pearls. The shape, structure and size of these crystals are critical to producing the iridescent glow of pearls. This is easily measured with the nGauge along with roughness and orientation of the crystals.



Aragonite crystals on a pearl under the nGauge